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Impact of Ultraviolet C Light for the Management of Infectious Keratitis

Dr. Bhumi Chandarana

Department of Ophthalmology

Abstract: ***This study evaluates the effectiveness of Ultraviolet C (UVC) light in treating infectious keratitis. Conducted as a prospective interventional study, it involved 138 patients with corneal ulcers divided into two groups: one received standard antimicrobial therapy with UVC light, the other received only antimicrobials. Results showed a significantly higher healing rate in the UVC group (81% vs.50%), though UVC did not significantly reduce non - healing ulcer cases. The findings suggest UVC is a promising adjunct therapy due to its broad antimicrobial activity, especially valuable in the context of increasing antimicrobial resistance. Further research is recommended to confirm its benefits.***

Keywords: Infectious Keratitis, Ultraviolet C Light, Antimicrobials.

1. Introduction

Infectious keratitis (IK), a vision - threatening condition, is particularly prevalent in developing countries such as India. The condition often results from microbial invasion of the cornea leading to inflammation, stromal degradation, and potential vision loss. Standard treatments with topical antimicrobials, while effective in many cases, are increasingly challenged by issues like microbial resistance, limited availability of antifungal agents, poor drug penetration, and high treatment costs. Ultraviolet C (UVC) light, ranging from 200 to 280 nm in wavelength, has emerged as a promising alternative antimicrobial modality. Its germicidal effect stems from its ability to damage microbial DNA, leading to cell death through the formation of cyclobutane pyrimidine dimers. [(2)] This study explores the use of UVC as an adjunct to standard antimicrobial therapy in treating infectious keratitis. [(3)]

2. Objectives:

Primary Objective:
- To evaluate the efficacy of UVC light in managing infectious keratitis.

Secondary Objectives:
- Assess visual acuity (VA) improvement with UVC + antimicrobial therapy.
- Compare treatment failure rates (e. g., corneal perforation, keratoplasty, evisceration) between groups.
- Study the impact of clinical risk factors (ulcer size, diabetes) on treatment outcomes.

3. Methodology

Study Design:
- Type: Prospective interventional study
- Duration: March 2022 – March 2023
- Sample Size: 138 patients.

Study Groups:
- Group A (n=76): Received UVC light therapy in addition to standard antimicrobial treatment.
- Group B (n=62): Received only standard antimicrobial therapy.

Inclusion Criteria:
- Age 15 to 80 years.
- Clinically diagnosed infectious keratitis (2–8 mm ulcer size).
- Ulcer depth up to two - thirds of corneal thickness.
- Consent to participate.

Exclusion Criteria:
- Pre - existing corneal pathologies, corneal perforation, or descemetocele.
- History of collagen cross - linking.
- Allergy to treatment agents or inability to consent.

Intervention Protocol:
- Patients were randomized into two groups.
- Group A underwent 3 minutes of UVC exposure.
- Both groups received antimicrobial treatment and supportive therapy.
- Follow - ups were scheduled every third day over 10 days, evaluating clinical features and documenting anterior segment images.

Outcome Measures:
- Healing: Defined by complete epithelial closure, reduced infiltrate, and improved vision.
- Failure: Included corneal perforation, need for emergency surgery, or non - response.

4. Results

Demographics:
- Mean Age: 42.68 years (Group A), 49.96 years (Group B)
- Gender Distribution: ~55% male, 45% female across both groups

Risk Factors:
- Ocular trauma was the most common risk factor (57.2% of cases).

Ulcer Characteristics:
- Majority of ulcers were centrally located (75%+ in both

groups).
- Common ulcer size was between 5–6 mm.

Initial Visual Acuity (VA):

Visual Acuity Range	Percentage of Patients
< 1/60	37%
1/60 – 3/60	28.3%
6/60 – 6/36	13.8%
6/24 – 6/18	13%
6/12 – 6/9	5.8%
6/6 – 6/5	2.2%

Healing and Visual Outcomes:

Outcome Measure	Group A (UVC)	Group B (Control)	p - value
Healing Rate	81%	50%	< 0.0001
Visual Acuity Improvement	57%	28%	0.001

- Significant healing and visual recovery were observed in Group A compared to Group B.
- No adverse effects related to UVC were reported.

5. Discussion

This study presents compelling evidence for the role of UVC light as a valuable adjunct in the treatment of infectious keratitis. The high healing rate and significant vision improvement in the UVC group suggest that this modality enhances the efficacy of antimicrobial therapy.

Mechanism of UVC Action:
- UVC damages DNA by forming pyrimidine dimers.
- Prevents microbial replication leading to cell death.
- Effective against a wide range of pathogens including bacteria, fungi, and resistant strains.

Supporting Evidence:
- Animal models and in vitro studies corroborate findings.
- Inhibition of Pseudomonas, Staphylococcus, Candida, and other pathogens has been shown with brief UVC exposure. [6] [7]

Advantages of UVC Therapy:
- Broad - spectrum antimicrobial effect
- Minimal toxicity to human corneal tissue
- Cost - effective and simple to implement
- Suitable for resource - limited settings

6. Limitations

- Single - centered design
- Short follow - up duration
- Non - double - blinded evaluation

7. Conclusion

Ultraviolet C light therapy demonstrates significant clinical benefits in the management of infectious keratitis. When used alongside standard antimicrobials, it:
- Accelerates ulcer healing,
- Enhances visual acuity,
- Reduces complications associated with delayed treatment.

8. Summary

UVC is a promising tool, especially in areas with limited access to advanced microbiological diagnostics or where antibiotic resistance is rampant.

9. Recommendations

- Conduct larger multicenter randomized controlled trials.
- Assess long - term safety and recurrence rates.
- Explore standardization and commercial development of ophthalmic UVC devices.

Visual Chart

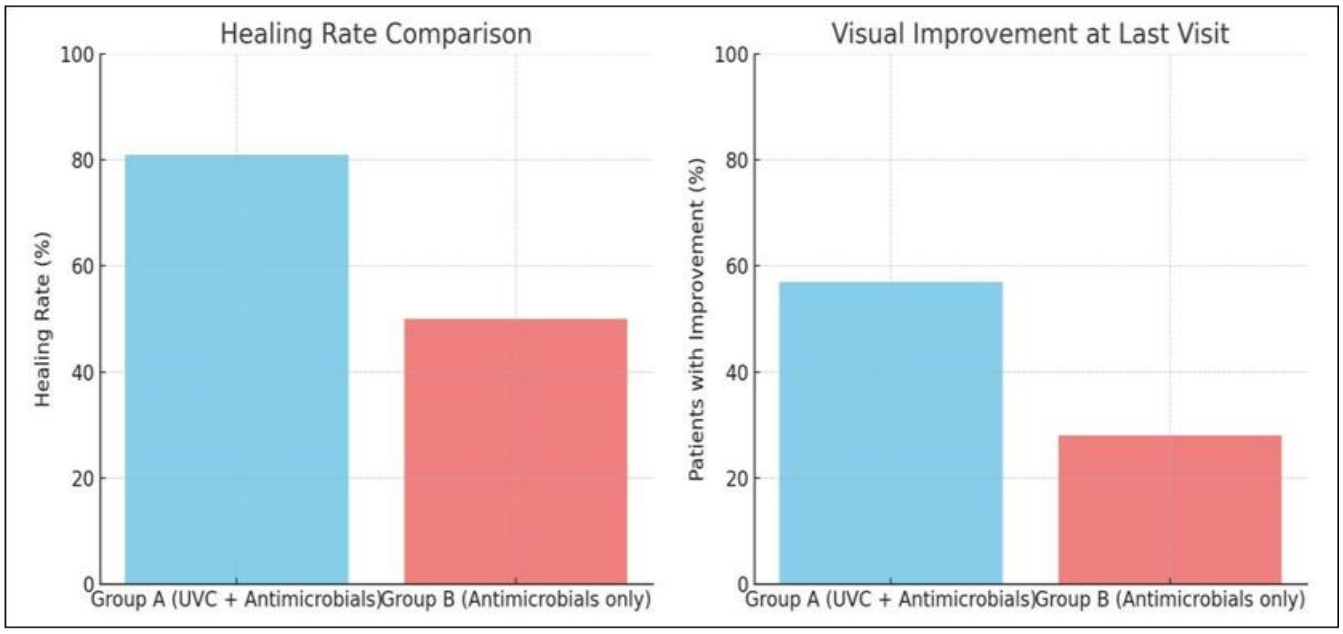

Chart: Healing and Vision Improvement

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